“DO AG-GAG LAWS AFFECT FARM BUSINESS INVESTMENT? A COMPARATIVE CASE STUDY”

by

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(Under the Direction of Benjamin Campbell)

ABSTRACT

Ag-gag laws have been controversial since their inception in the early 1990s with Kansas passing the first law in 1990 followed by North Dakota and Montana passing laws in 1991. I used state level annual panel data and the synthetic control method to evaluate the effect of these laws on feeder cattle and hog inventories. These inventories act as a proxy for farm business investment. The results suggest that there was no effect on farm business investment for Kansas, North Dakota, and Montana over the time period of 1980 to 2010.

INDEX WORDS: “Ag-gag law” “Synthetic control estimation” “Livestock” “Farm investment” “Animal Welfare”

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DEDICATION

I dedicate this thesis to my parents, sister, and JP. Mom, thank you for instilling a love for agriculture and the environment in me and teaching me that anything good comes from hard work and never to settle for anything less. You have taught me what a strong woman looks like and I couldn't have a better role model. Dad, thank you for supporting me through my many melt downs and letting me know it would all work out in the end. Mom and you have been my biggest fans and I will never be able to say how I grateful I am for the support through the years. Ash, thank you for being my best friend, without your love and support I don't know where I would be. I know it's been hard for the last 6 years but I'm happy to have you by my side through life. JP, I'm beyond grateful for you. You have centered your whole life around me these past 2 years by taking me on vacations, cooking for me so I can relax when I get home, and making sure I had everything I ever needed. You have been my rock, my everything. I can't wait to for the next step in our life and I'm so lucky that we get to spend the rest of our lives together. I'm so thankful every day that I have you all for as a support system and I couldn't have done graduate school with you. Also, a big thanks to the lunch crew for putting up with my complaining and helping keep me sane throughout this process.

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CHAPTER 1

INTRODUCTION

According the USDA, the livestock and poultry account for over half of the U.S. agricultural cash receipts, often exceeding $100 billion per year (USDA ERS 2016). The US fed cattle industry is the largest in the world with being valued at $78.2 billion in 2016 and the hog industry is was valued at $26.5 billion in 2014 (USDA NASS 2016). US agriculture contributes to about 1% of the nation's GDP (*Ag* 2018). As of Jan 1st, 2017, the states that raise the most cattle and calves are Texas, Nebraska, Kansas, California, and Oklahoma (*Industry* 2018). The top producing hog states are Iowa, North Carolina, Minnesota, Illinois, and Indiana (*State* 2018).

In 2017, there was viral video showing workers abusing dairy cows at a Florida dairy (Associated Press, 2017). The video showed workers hitting and using a blowtorch to sear the hair off the udders of the milking cows. Undercover investigators record videos and audio to expose the living conditions of animals in an attempt to expose animal abuse (Eller 2019). These investigators are often hired fraudulently as farm workers, but their main job is to secretly film conditions on the property. Usually the videos are of one farm or person and are made out to represent the agricultural industry as whole. The investigators release these videos to the public as fact, sometimes they are accurate and other times they are edited and dramatized to meet the investigator's agendas.

Over the last 30 years states have been trying to pass these to prevent the undercover filming or photography of activity on farms without the consent of the owner often referred to as Ag-gag laws. Over half of the states in the US have tried to pass these laws with little success.

These laws often enhance upon a state's statutes that make it illegal for trespass and distribute the videos. Each of these states have either attempted or successfully passed the Ag-gag laws. To this date there are only 6 states that have these laws: Kansas, Arkansas, North Dakota, Missouri, North Carolina, and Montana. These laws are also known as property protection acts and they have been a controversial policy among animal's rights groups, the media, and the agricultural community since the laws target extremist groups and whistleblowers. Advocates say these laws are necessary to protect the producers' property rights and safeguard their business reputations. If these laws are in effect, then agricultural producers may be more inclined to invest more into their operations by acquiring new facilities or increasing their number of animals. Some livestock producers oppose these laws since they may instill distrust in farmers. Broad (2014) showed that these laws could create an impression that animal agriculture is trying to hide something, leading to public mistrust. Many of the efforts to pass these laws have failed in state legislatures, while others have passed to then be struck down in courts. This is usually due the court's believing that certain parts of the laws violate the First Amendment with respect to freedom of speech and freedom of the press due to the law limiting the potential for investigative journalism. Courts have upheld some parts of the laws by focusing on the intent behind the law.

There is some concern for that these laws affect demand for meat. Tonsor and Olynk (2011) showed that media attention to animal welfare has significant, negative effects on long-run demand for meat. The lost demand is found to exit the overall meat demand complex instead of spilling over and enhancing demand of competing meats such as beef. This could signal that people are changing their preferences from animal protein to plant-based protein after negative media covering animal welfare is released.

Do these laws provide a beneficial benefit to agricultural producers that are located in the states that pass these laws? I use the synthetic control method (SCM) to address if Ag-gag laws effected the inventory numbers of feeder cattle and hogs. The livestock inventories act as a proxy for the business investment that farmers and ranchers are putting into their operations. I used Kansas, Montana, and North Dakota livestock inventories since they were the first states to implement these types of laws with Alabama and Texas following suit in more recently. Kansas enacted their law in 1990 and Montana and South Dakota followed quickly in 1991. I demonstrate that there was no effect from the Ag-gag laws on both feeder cattle and hog inventories for each state. Essentially, there was no effect on farm business investment from these laws.

CHAPTER 2

BACKGROUND

Confinement operations like feedlots and hog operations are often the subject of undercover videos that are released to the media highlighting animal abuse or the conditions of the facility. Typically recordings take place is when the cattle are in feedlots and at the slaughter houses. Hog farms are often targeted since they are the entirely confinement based.

For the first year of cattle's life, they go from the cow-calf operation to stockers after they are weaned. Then they reach the appropriate age to be finished in the feedlots.   At the feedlots, the diet is changed from a predominantly forage-based diet to a grain-based diet. Due to this, the majority of feedlots are located around the edge of the Plain States since that is where the feed is cheaper. Once beef cattle are transferred to feedlot operations, the feedlots are typically more confinement based where the typical allocation of space is 125-250 square feet per animal. Cattle tend to stay in feedlots for 120-180 days prior to slaughter.

In contrast to beef cattle, hog production happens at a more rapid pace since farrowing to finishing takes about 16-17 weeks. The entire process tends to be indoors; therefore, it is considered by some as an extreme version of a confinement operation. Their diet is grain-based made up mostly of corn and soybean meal therefore the majority of the operations are located in the Midwest and North Carolina. Hogs usually spend their entire lives on the same farm just moving from barn to barn until time for slaughter.

The Ag-gag laws make it illegal to photograph, video, or record sounds at an agricultural facility without consent. These laws provide a criminal penalty for people that gain employment under false pretenses, obtain documents by force, threat, misrepresentation, or trespass, record an image or sound from the facility without permission, or gain entry to a facility under false presences. These laws often strengthen existing laws, where conversion, trespass, and fraud already provide remedies for such interferences. These laws were advanced by the animal production industry and some producers, but some agricultural associations and producers are against them since it can lead to public mistrust of the farmers and ranchers (Radke 2012). Many in the public and media are against the laws since it limits the potential for investigative reporting (Robbins 2015). It is generally accepted that if a person is engaging in a practice that abuses animals or violates safety rules then they should not be protected by the law.

Ag-gag laws have been around for almost 30 years in the United States dating back to 1990 when Kansas first passed their law. These laws came about as industrial agriculture was taking off in the late 1980s. Animal rights activists and consumer protection groups were growing concerned about the welfare of farmed animals. A few producers and processing facilities had their unfavorable and inhumane conditions exposed by undercover agents, and, as a result, these farms experienced financial losses and then sought legislative assistance to help protect themselves from undercover investigators. In January of 2018, the Hallmark-Westland Meat Packing Company in California was investigated for abuse. The investigation resulted in a large multi-million dollar lawsuit, the largest recall on meat in U.S. history, multiple felony convictions based on animal cruelty and Hallmark-Westland ended up in bankruptcy.

The producers and processors wanted to block the investigators from releasing pictures, videos, and sounds of the conditions and potential animal abuse. These videos and photos that were taken and released to the media often led to recalls, boycotts, and termination of contracts, and bankruptcy. Initially these laws were passed to deter activists from trespassing and destroying property. Now, the laws that have been written more recently focus on audio and video recordings that result in economic damage (Prygoski 2015).

Kansas has the nation's oldest Ag-gag law passed in 1990. According to the statute it is a crime for anyone to destroy property or take a pictures or videos at animal facilities without the owner's consent or to enter them under false pretenses (K.S.A. §47-1827)**.** This law provides criminal penalties to anyone that violates this statute in terms of misdemeanors and monetary fines. The farm has the right to file a suit if there are any damages incurred when the law was violated. While not exactly the same as Kansas', Montana's Ag-gag law bans recording with "the intent to commit criminal defamation" (MCA §81-30-103). North Dakota similarly passed their law in 1991 and it takes a broader stance then Montana's. North Dakota's law states that "No person without the effective consent of the owner may . . . enter an animal facility and use or attempt to use a camera, video recorder, or any other video or audio recording equipment" (NDCC § 12.1-21.1-02).

These laws from their inception have been controversial. Over half the states have tried to pass these types of laws with little success. If the state does pass a law, then the state may be sued by consumer protection and animal welfare groups**.** In 2013, Amy Meyer was arrested and charged for violating Utah's "agricultural operation interference" law for filming workers move a sick cow with heavy machinery. She was the first person to be arrested under an Ag-gag law in the United States. In 2017, after Meyer challenged Utah's law, a federal judge ruled in favor of Meyer since the court agreed that the Utah law violated her First Amendment rights. Judge Shelby said that Utah failed to prove that the ban was intended to ensure the safety of the animal and farm workers from disease or injury (*Animal Legal Defense Fund v. Herbert, 2017).*

At the end of 2018, a group of animal rights and consumer protection groups filed a suit over Kansas' Farm Animal and Field Crop and Research Facilities Protection Act (K. S. A. § 47-1825 – 1830) in the U.S. District Court in Kansas. According to the lawsuit, the law violates the First Amendment. Several other states have had their laws brought before a court for violation of constitutional rights. In the 9th circuit, the court ruled on the constitutionality of Idaho's "Interference with Agricultural Production" law that was passed in 2014. The court's decision found that there was a constitutional right to record images on private property like a farm under the First and Fourteenth Amendment (Animal Legal Defense Fund v. Wasden, 2018*)*. Some parts of the Idaho law were upheld like sections (b) and (c) where there was an articulated purpose in the record like protecting breeding records and obtaining employment with a facility by misrepresentation (Animal Legal Defense Fund vs. Wasden, 2018). This decision has shaped what types of provisions are allowable when drafting farm protection laws for the future.

CHAPTER 3

LITERATURE REVIEW

There is a gap in the literature about Ag-gag laws and it'sthe economic effects on society. Traditional methods of policy analysis use difference-in-difference which has strong assumptions for the analysis to be valid. The Synthetic Control Method (SCM) extends the difference-in-difference framework and is more flexible by relaxing some of the assumptions (Abadie 2010). Previous comparative case study literature shows that there is an ambiguity about how comparisons are chosen, and the techniques used only measure the uncertainty about aggregate values of the data in the population in the traditional comparative case studies framework. To combat these issues, Abadie and Gardeazabal (2003) introduced SCM since it's a data driven procedure to contrast a suitable counterfactual. SCM was expanded upon in Abadie et al. (2010), and Abadie et al. (2015). This method makes a synthetic state as if the state of interest never passed a policy of interest.

SCM relaxes the "parallel trends" assumption that the difference-in-difference method relies on. The "parallel trends" assumption ensures the validity of the difference-in-difference and violation of this assumption leads to biased estimation of the causal effect. It requires that in the absence of the treatment, the difference between the 'treatment' and 'control' group is constant over time. SCM allows the effects of the unobserved variables on the outcome vary with time.

The “parallel trends” assumption can be too constrictive and SCM extends the difference-in-difference framework by relaxing the “parallel trends” assumption. Abadie and Gardenazabel (2003) show that using SCM has benefits such as being more transparent and safeguards against extrapolation, it provides a weighted average of available control units, and doesn’t require access to post-intervention outcomes. This allows researchers to decide on study design without knowing how those decisions will affect the conclusions of their study. The flexibility of SCM allows it to be used at the micro or macro level. Another benefit is that the SCM doesn’t require a huge number of comparison units in the donor pool.

McClelland and Gault (2017) have broken down SCM and presented several assumptions that need hold. First and foremost, when running the model, no region (states) in the donor pool can have a similar policy change. They have also suggested to avoid interpolation bias, the variables used to form the weights must have values for the donor pool regions that are similar to those for the affected region. The values of those variables for the policy region cannot be outside any linear combination of the values for the donor pool. Therefore, the variables and the outcome must have an approximate linear relationship.

Cunningham (2018) points out that the weight chosen for the counterfactual state is explicit in what each unit is contributing. With SCM the weights chosen can be debated especially when a state contributing to the synthetic state that may not be similar to the state of interest. SCM provides more transparency when compared to regression-based comparative studies (Cunningham 2018).

Powell (2018) points out some weaknesses in the initial SCM methodology. He improves upon it through the use of imperfect synthetic controls. One restriction of the original model is that the treated unit belongs to a “convex hull” of the control units. The original SCM assumes that the there exists a synthetic control such that the pre-intervention fit between the synthetic control and the treated unit is perfect. This would lead to biased weights if there isn't a perfect synthetic control. Using the imperfect synthetic control may reduce bias associated with the SCM by relying on two insights. If the convex hull doesn't hold for the treated unit, the treated unit may be a part of an appropriate synthetic control for one or more untreated unit. It is possible to estimate consistent synthetic control weights by first predicting the value of outcome variable using unit-specific trends. Powell (2018) also addresses the issue of overfitting by using predicted values from pre-intervention outcome values (due to a two-step process). They have emphasized that this method reduces concerns of overfitting.

Previous studies have used SCM to model health outcomes (Powell 2018), the economic impact of terrorism (Abadie and Gardenazabel 2003) and other general policies implemented at the state level (Abadie et al. 2010). SCM has been covered extensively from its initial use with continued development. But there is a gap in the literature about Ag-gag laws, and the law's economic effect on society. Tonsor and Olynk (2011) provide an assessment of US meat demand impacts from increasing media attention to animal welfare. They found that there were small but significant effects when compared with price and expenditure effects. Their results suggested that long-run demand for pork and poultry is hampered by increasing press on animal welfare issues and that loss of demand instead was relocated non-meat expenditures. The paper didn't speculate on extent of consumer exchanging their demand for animal-based protein for other protein sources.

Robbins et al. (2016) does provide insight on the public's view of Ag-gag laws. Their study showed that the restricted flow of information coming out of farms reduced trust in farmers. It was observed that there was a reduction in trust in both the initially most trusting demographic (conservative, rural, omnivores) and the least trusting demographic (liberal, urban, vegetarians). This emphasized a shift from slightly trusting farmers to slightly distrusting farmers and that low levels of trust are associated with increased support for sanctions for animal abuse. Individuals or organizations that attempt to block information coming out of farm might seem to increase the credibility of the antagonists like People for the Ethical Treatment of Animals (PETA) and the Humane Society of the United States (HSUS) increased credibility even if they are the antagonist. This is consistent with the trend that consumers' want more transparency in the food industry and restricting information can have a negative effect on the reputation of farmers and ranchers.

CHAPTER 4

DATA

I used annual state-level panel data for the period 1980-2010. The Ag-Gag laws of interest were passed in 1990 in Kansas and 1991 in Montana and North Dakota. This gives at least 10 years of pre-intervention data. The sample period began in 1980 since that is the first year that the data was available for all the variables. The period ends in 2010 since that is when the data becomes less complete. Additionally, a period of two decades after the policy implementation seems like a reasonable timespan for any effect from the laws to show.

The synthetic state is constructed from a weighted average of potential control states. The weights are chosen so that the resulting synthetic state is best reproduced by a set of predictor variables that mimic the changes in the livestock inventories in the states before the passage of Ag-gag laws. The synthetic state attempts to reproduce the livestock inventory numbers if the laws were never passed. To remove any influence of the laws from the synthetic state, states that adopted similar laws during the time period cannot be included in the control group. This study focuses on Kansas, Montana, and North Dakota since they were the first states to adopt these laws. Kansas adopted theirs in 1990, Montana and North Dakota followed suit with adopted their laws in 1991. Alabama enacted their law in 2002 therefore it was removed from the donor pool. Texas also recently adopted their own version in 2017 but was kept in the donor pool since their law was passed after the end of the data period. Feeder cattle and hogs were chosen since their state level inventories were the most complete for confinement-type operations.

Alaska, Hawaii, Connecticut, District of Columbia, Maine, Massachusetts, New Hampshire, Nevada, Rhode Island, and Vermont were dropped due to lack of data over the time periods.

The outcome variable of interest is the inventory numbers for feeder cattle and hogs, measured in head at the state level. This data comes from the National Agricultural Statistic Service (NASS). I used inventory numbers for feeder cattle and hogs as to focus on confinement-type operations since they potentially would benefit the most from Ag-gag laws. The feeder cattle and hog data ranges from before 1970 to 2010, providing more than 50 years.

Using this data acts as a proxy for farm business investment, looking to see if farmers or ranchers are investing more into their agricultural operations due to the passage of Ag-gag laws. Since the inventory data is acting as a proxy, it isn't going to be exact representation of the farm business investment; there may be other reasons for changes in the inventory numbers. To combat this, I used predictor variables that can control for changes that aren't directly related to the policy. For the predictors of inventory values, I used: prices received for cattle, prices received for hogs, average price received for corn price, tax burden percentages, feeder cattle basis, lean hog basis, and corn basis. Appendix A provides data sources.

The corn, feeder cattle, and hog pricing data is broken down by year and state. The beef and pork demand indices provide a control to account for changes in consumers' demand for beef and pork from 1980 to today with the base being 100 in 1980. The net exports for both beef and pork products are used to control for changes in global demand. To get a sense of the political climate in each state, I used the tax burden percentages for each state. These tax burden percentages are calculated by the total amount paid by the residents in taxes divided by the state's total income. To control for volatility and the fluctuations in the futures markets, I used state level basis data. The basis variables were calculated for feeder cattle, lean hogs, and corn from prices received and historical continuous futures contracts. I used cash prices received from each state for each category and subtracted the historical continuous contract for April settled prices that were averaged over the year to get the data.

CHAPTER 5

METHODS

The data was used to run 5 models total: both Kansas and North Dakota have a separate model for both Hogs and Feeder Cattle and Montana only has a cattle model. By using the synthetic control method, I create a synthetic Kansas, Montana, and North Dakota that can be used as a comparison to the real state to evaluate the effect of the Ag-gag laws. The SCM allows for the creation of the optimal synthetic control. Abadie and Gardeazabal (2003), Abadie et al (2010), and Abadie et al (2015) relaxed the "parallel trends" assumption that is used in traditional difference-in-difference framework. The synthetic control creates an optimal synthetic control from a set weighted average of the control units which best approximates the treated unit in the pre-intervention period. This method allows for an estimation of the policy effect associated with Ag-gag laws by comparing the actual state against the created synthetic state. The synthetic states are created as if the Ag-gag laws were never passed in the state of interest. If there is a statistically significant difference between the states, the law had a significant impact on the hog and feeder cattle inventory numbers.

Let Y_{it} be the outcome of interest for unit *j* for J +1 aggregate units at time *t*, and the treatment group be j =1. The synthetic control estimator models the effect of the intervention at T_0 on the treatment group using a linear combination of optimally chosen units as a synthetic control. For the post-intervention period, the synthetic control estimator measures the casual effect as

$$Y_{1t} - \sum_{i=2}^{i+1} w_i^* Y_{it}$$

where w_i^* is a vector of optimally chosen weights.

To measure the difference between the real state and its synthetic counterpart. Use X_1 and X_0 are chosen as predictors of post-intervention outcomes and must be unaffected by the intervention. X_1 is a (*k x1*) vector of the preintervention characteristics for the exposed regions and X_0 is a (*k x J*) matrix that contains the same variables for the unaffected regions. The weights are chosen to minimize the distance between X_1 and X_0W, $\|X_1 - X_0W\|$, subject to two weight constraints. Firstly, let $W = (w_2, \ldots, w_{J+1})'$ with $w_j \geq 0$ for $j = 2, \ldots, I + 1$. Second, a unit can't receive a negative weight but can receive a weight of zero. The combination of weights must sum to one. Each value of weight represents a weighted average of the available control regions.

To measure the discrepancy between X_1 and X_0W, I used

$$||X_1 - X_0W||_V = \sqrt{(X_1 - X_0W)'V(X_1 - X_0W)}$$

where V is some (*kxk*) symmetric and positive semi-definite matrix. The optimal choice of V assigns weights to linear combination of the variables in X_1 and X_0 to minimize the mean square error of the synthetic control estimator. The V is important since W* is based off it. The synthetic control W*(V) is meant to reproduce the behavior of the outcome for the treated unit in the absence of the treatment.

The treated unit in this case is the states that passed the Ag-gag laws. All the other states are part of the donor pool that can contribute towards the synthetic state. The state is exposed to the treatment in periods T_0+1 to T and unexposed in periods 1 to T_0, where the T_0 is the number of preintervention periods. The states in the donor pool can create the weighted combination that minimizes the difference between the state pre-treatment outcomes of the law that was passed. It is assumed that the outcomes of the states in the donor pool that are untreated to the policy change. When I ran the 5 models, I dropped the states that enacted similar policies to the state of interest. For example, when running the model for Kansas I dropped North Dakota, Alabama, and Montana to prevent these states from contaminating the donor pool.

To evaluate the ability of the SCM to create a suitable counterfactual state, I compared the predictor means between the real state and the counterfactual state. If the predictor means are similar, then the SCM creates a suitable synthetic state for the model.

To assess the effect generated by the synthetic control method to produce the counterfactual state (Kansas, North Dakota, and Montana), I used a placebo study by applying the same synthetic control method to every donor state in the sample. This test provides a way for quantitative inference to be produced in comparative case studies. This test checks if the difference estimated between the real and synthetic state policy treatment is statistically larger than a difference estimated for a region chosen at random. By using a placebo test, I can calculate of the exact distribution of the estimated effect of the placebo interventions.

The intervention is applied to each state in the donor pool and the state of interest is included into the donor pool to act as a “randomization” of the treatment. The SCM is applied to all the potential donor states to create its own counterfactual state and obtain a distribution of placebo gaps. For each placebo, I calculated a pre-treatment RMSPE (root mean square prediction error) and a post-treatment RMPSE. Then I computed the ratio of the post-to-pre-treatment RMSPE and sorted the RMPSE from greatest to least. This allowed me to find the post-to-pre-treatment RMSPE’s p-value from the distribution of placebo gaps as $p = \frac{Rank}{Total}$. This allows for comparison of the p-value for state of interest to the states from the donor pool. This provides a relative idea if the state of interest's treatment effect is extreme compared to the donor pool's placebo ratios.

Generally, the placebo test allows for the examination of whether or not the estimated effect of the actual intervention is large relative to the distribution of the effects estimated for the states not exposed to the treatment. This is informative to test against a hypothesis that there is no effect from the laws. Underneath the null hypothesis, the estimated effect of the intervention is not expected to differ relative to the distribution of the placebo effects. If the magnitude of the placebo studies are similar to the state of interest, then the interpretation is that the analysis does not provide significant evidence towards the hypothesis that Ag-gag laws have a positive effect on farm business investment.

CHAPTER 6

RESULTS

As explained in the previous sections, I used the synthetic control method to provide a systematic way to estimate the counterfactual states. There are 5 different models breaking up the results section into two, one section for feeder cattle and one for the hogs. I used these two inventory models as comparisons for results.

Table 1: Cattle Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Observations	
Cattle	3.156	2.655	.81	1.51	N=	837
Corn Prices	2.793	.8114	1.37	6.12	N=	837
Cattle Prices	64.93	13.67	33.29	110.46	N=	837
Tax Burden	.0954	.0114	.063	.128	N=	837
Cattle Basis	-16.24	10.87	-59.58	8.257	N=	837
Corn Basis	-.1150	.3987	-1.623	1.42	N=	837

Table 1 displays the overall summary statistics of the cattle inventory models and Table 2 displays the overall summary statistics for the hog inventory models. The variables of interest in the model are cattle and hog inventories for each of the states. Hog is number of hogs within each state and cattle is the number of feeder cattle within each state. Scaled the hog and cattle inventories by dividing them by 1 million so that they are able to use. The observations for the hog inventory model are less than the cattle inventory, since there was less data available.

Table 2: Hog Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Observations	
Hog	2.721	3.570	.015	19.9	N=	620
Corn Prices	2.711	.8040	1.37	6.12	N=	620
Hog Prices	44.03	6.418	25.4	57.302	N=	620
Tax Burden	.0959	.0106	.069	.128	N=	620
Hog Basis	-15.24	13.56	-43.13	9.475	N=	620
Corn Basis	-.1968	.3433	-1.285	1.208	N=	620

The difference in the summary stats between the cattle and hog inventory datasets is due to different states in the datasets. The panel dataset for cattle contains data from 29 states over the time period of 1980 to 2010. The panel dataset for the hog contains data from 20 states over the time period of 1980 to 2010.

The mean corn price for the cattle inventory is higher at 2.79 dollars per bushel than the corn price for the hog inventory which is 2.71 dollars per bushel. Cattle prices and Hog prices are in dollars per hundredweight (CWT). The Cattle prices have a $64.93 per CWT. The mean hog price is $44.03 per CWT. The cattle tend to have a higher price per hundredweight since they require more inputs then hogs do. Tax burden is a ratio of total amount paid by the residents in taxes divided by the state's total income. The mean tax burden is 9.54% for the cattle inventory. The mean tax burden for hog inventory is 9.59%. All the basis variables have a mean which is negative which means that the spot prices are typically lower than the futures prices. The cattle and hog basis are shown in cents per pound. The cattle basis has a mean of -16.24 cents per pound. The hog basis has a mean of -15.24 cents per pound. Corn basis is in cents per bushel. The cattle inventory corn basis has a mean -11.50 cents per bushel and the hog corn basis has a mean of -19.68 cents per bushel.

Cattle

Kansas Cattle

Table 3: Cattle Inventory Predictor Means

Variables	Real Kansas	Synthetic Kansas
Corn Price	2.53	2.53
Cattle Price	62.50	62.45
Cattle Basis	-7.26	-7.24
Corn Basis	-.128	-.128
Tax Burden	.094	.094
Cattle(1980(1)1989)	5.9255	5.92205

I constructed a synthetic Kansas from a convex combination of states from the donor pool that most resembles the values of cattle inventory in Kansas before it passed its Ag-gag law, the Farm Animal and Field Crop and Research Facilities Protection Act. The predictor means results are shown in Table 3, which compares the pretreatment characteristics of the actual Kansas to the synthetic Kansas. Table 3 highlights the values that minimize the mean squared prediction error of cattle inventory in Kansas before the law passed between the real state and its synthetic counterpart. Since the predictor means are roughly the same for both the real and synthetic Kansas, the synthetic Kansas accurately reproduces the values for cattle inventory for the synthetic Kansas.

Table 4 shows the weights of each control state in the synthetic Kansas. Colorado, Nebraska, and Texas contribute the most weight towards the creation of the synthetic Kansas. This makes sense the states being heavily involved in feeding beef cattle for harvest. All the other states with an exception of Iowa contributed a small amount towards the synthetic Kansas. It is interesting that Iowa was the only state to take a weight of zero.

Table 4: State Weights for the Synthetic Kansas

State	Weight	State	Weight
Arizona	.003	Missouri	.008
Arkansas	.004	Nebraska	.426
California	.006	New Mexico	.004
Colorado	.331	Ohio	.004
Florida	.004	Oklahoma	.008
Georgia	.003	Oregon	.003
Idaho	.004	Pennsylvania	.004
Illinois	.005	South Dakota	.011
Iowa	0	Tennessee	.004
Kentucky	.004	Texas	.14
Louisiana	.003	Virginia	.004
Michigan	.003	Wisconsin	.004
Minnesota	.003	Wyoming	.006

Figure 1: Trends in Cattle Inventory: Kansas vs. synthetic Kansas

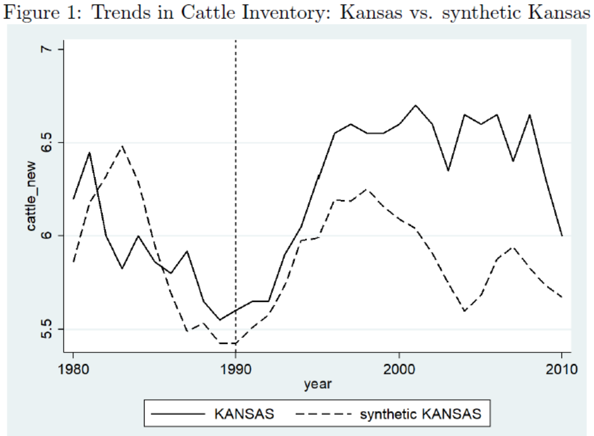
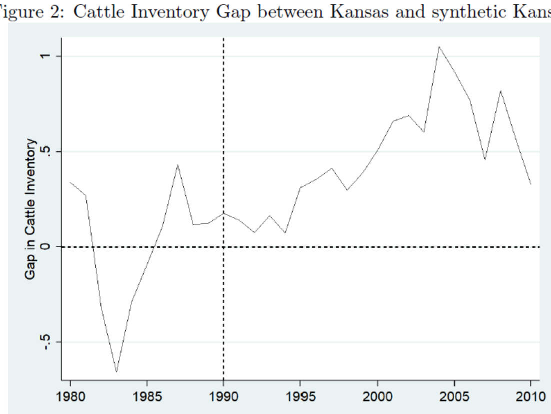


Figure 1 displays the cattle inventory numbers for Kansas and its synthetic counterpart during the period 1980-2010. Combined with the cattle inventory predictors from Table 3, this suggests that the synthetic Kansas provides a suitable approximation of the number of cattle in Kansas in 1991-2010 in the absence of the passage of the Ag-gag law. The estimated effect of the Ag-gag laws on cattle inventory in Kansas is the difference between cattle inventory in Kansas and its synthetic counterpart after the Ag-gag law passed in 1990. Shown in the graph, the two lines tend to separate noticeably around 1994, not immediately after the law's passage in 1990. The synthetic Kansas trend lines stays underneath the real Kansas for the majority of the period. The real

Kansas lines jumps up more steeply then the synthetic Kansas' line around 1994. The difference between the two lines suggests a positive effect of the Ag-gag laws on the cattle inventory numbers.

Figure 2 plots the yearly estimates of the impacts of the Ag-gag law, this gap comes from the difference between the real Kansas and the synthetic Kansas. Figure 2 suggests that the Ag-gag laws had an effect on the cattle inventory numbers and the effect increased with time. The results show that the time from 1991 to 2010 that as a whole the cattle numbers increased with some years having more of an increase compared to others.

Figure 2: Cattle Inventory Gap between Kansas and synthetic Kansas



To evaluate the significance of the estimates, I used a placebo test to see if the results happen by chance. Similar to the test in Abadie et al (2010), I ran a placebo study by applying the policy intervention to every state in the donor pool that did not implement an Ag-gag law during the sample period. If the placebo studies create gaps of magnitude similar to ones that was generated for Kansas, then the interpretation is that the analysis doesn't provide significant evidence for a positive effect of the Ag-gag laws on cattle inventory. Figure 3 shows the results of the placebo tests. The thick black line is the gap for Kansas and the rest of the lines show the gaps for the other 26 states. The gaps lines show the difference between cattle inventory trend lines for each state in the donor pool and its synthetic counterpart. As Figure 3

Figure 3: Cattle Inventory gaps in Kansas and placebo gaps in all 26 control states

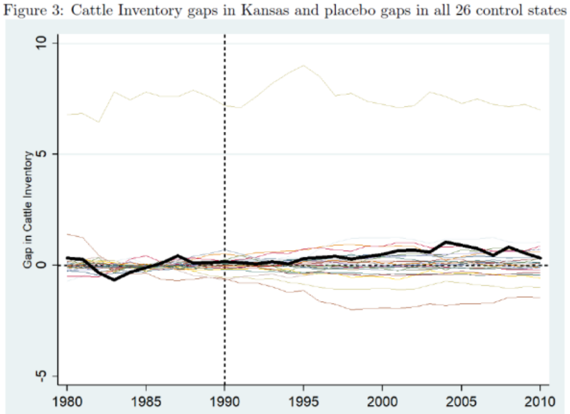
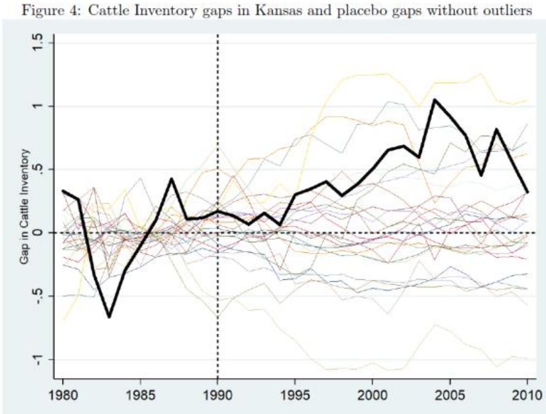


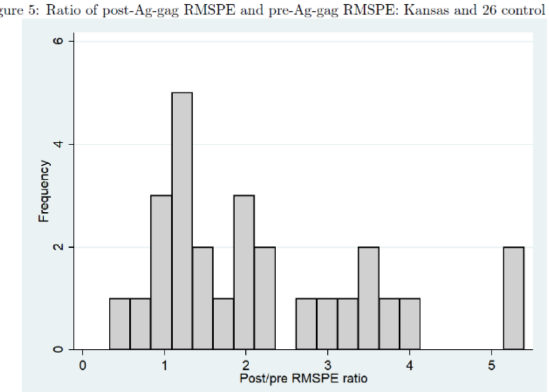
Figure 4: Cattle Inventory gaps in Kansas and placebo gaps without outliers



shows the gap line for Kansas does not appear different from the other gap lines. Figure 4 gives a clearer look at the placebo gaps without the outliers that was at the top of the graph in Figure 3. Figure 4 shows a clearer graph where states with a that have pre-Ag-gag RMSPE that is 2 times the size of the RMSPE for Kansas. Texas and Iowa were kicked out of Figure 4. The Texas pre-Ag-gag RMSPE was the largest with a value of 7.3823 and Iowa had a value of .7338.

To assess the significance of the Kansas gap relative to the gaps obtained from the placebo runs is to look at the ratios of the post/pre-Ag-gag RMSPE. Figure 5 shows the distribution of the post/pre-Ag-gag ratios of RMSPE for Kansas and the 26 control states. Kansas' ratio doesn't stand out from the others in the figure. Kansas' post-intervention RMSPE is 1.75 times the pre-intervention period. There are control states with larger ratios. With the distribution it has a p-value of .555 and the ratio is in the middle of the distribution of the placebo gaps. Therefore, I find no effect of the Ag-gag law on Kansas cattle inventory. Appendix B Table 1 contains all the results for the placebo tests.

Figure 5: Ratio of post-Ag-gag RMSPE and pre-Ag-gag RMSPE: Kansas and 26 control states



North Dakota Cattle

Just like Kansas above, I constructed a synthetic North Dakota from a convex combination of the states in donor pool so that the synthetic North Dakota closely resembles the real North Dakota before they passed their Ag-gag law in 1991 using the cattle inventory predictors. Table 5 highlights the predicator means for both the real North Dakota and the synthetic North Dakota. The predictor means aren't as balanced compared the Kansas cattle means in Table 3. This might suggest that the variables may not provide a suitable predictor values for creating a synthetic North Dakota especially cattle prices and cattle basis. The tax burden percentage and the lagged cattle variables are the most similar to the actual North Dakota values.

Table 5: Cattle Inventory Predictor Means for North Dakota

Variables	Real North Dakota	Synthetic North Dakota
Corn Price	2.33	2.44
Cattle Price	59.61	57.88
Cattle Basis	-11.42	-13.15
Corn Basis	-.314	-.204
Tax Burden	.098	.097
Cattle(1980(1)1990)	1.909	1.911

Table 6: State Weights in the synthetic North Dakota

State	Weight	State	Weight
Arizona	0	Missouri	0
Arkansas	0	Nebraska	0
California	0	New Mexico	0
Colorado	.363	Ohio	0
Florida	0	Oklahoma	0
Georgia	0	Oregon	0
Idaho	0	Pennsylvania	0
Illinois	0	South Dakota	0
Iowa	0	Tennessee	0
Kentucky	0	Texas	0
Louisiana	0	Virginia	0
Michigan	.507	Wisconsin	0
Minnesota	0	Wyoming	.13

Table 6 displays the weights for each state that creates the synthetic North Dakota. In contrast to the Kansas model above, only 3 states are used to create the synthetic North Dakota. These states are Colorado, Michigan, and Wyoming and all the other states from the donor pool contribute zero. Colorado and Wyoming make more sense to donate weight compared to Michigan where the most weight comes from. Michigan and North Dakota have similar values for corn basis. This could be the reason Michigan donates so much weight to the synthetic North Dakota.

Figure 6: Trends in Cattle Inventory: North Dakota vs synthetic North Dakota

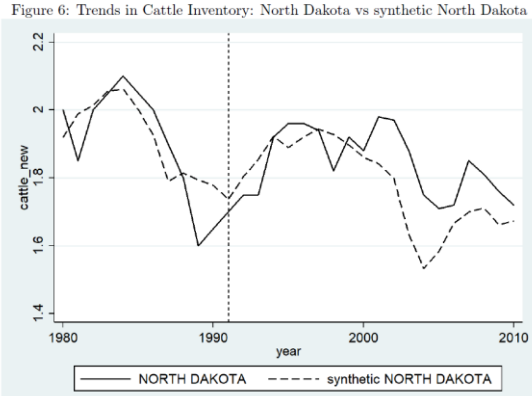


Figure 7: Cattle Inventory Gap between North Dakota and synthetic North Dakota

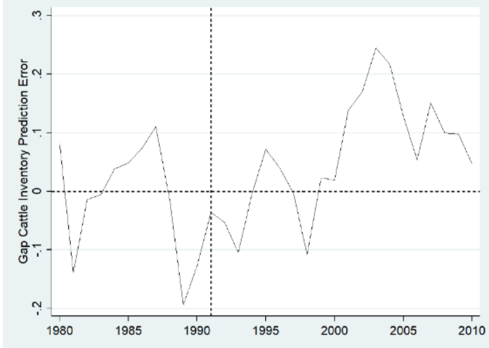


Figure 8: Cattle Inventory gaps in North Dakota and placebo gaps in all 26 control states

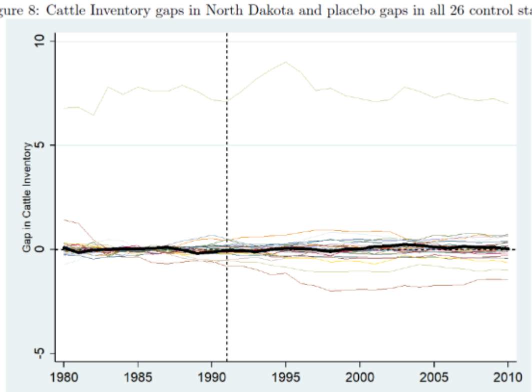
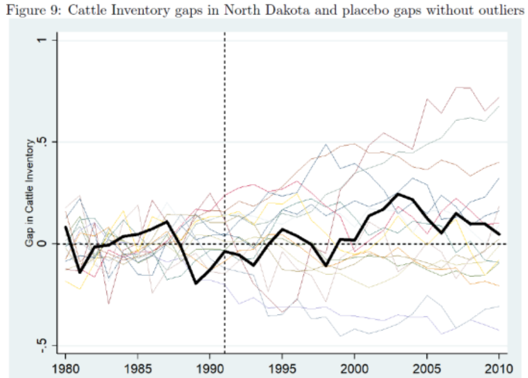


Figure 6 shows the cattle inventory for North Dakota and its synthetic counterpart for the period of 1980 to 2010. It looks like that there is little to no effect on cattle inventory from their Ag-gag law. The lines stay close together after the policy is passed. Figure 7 displays the gap between the line for the real North Dakota and its synthetic counterpart. This is the yearly estimates of impact on cattle inventory between the real and synthetic North Dakota. This suggests that there was no impact of the Ag-gag law on cattle inventory numbers in North Dakota. The line hovers between -200,000 and 250,000 at its most extreme points. The results would suggest that there is little to no effect.

As Figure 8 displays the results of the placebo test for North Dakota. The thick black line represents North Dakota while all the other thinner lines represent each of the 26 state gaps from the donor pool. As the figure shows, the estimated gap for North Dakota is mixed in within the placebo gaps from the donor states. The synthetic control method for North Dakota may not be the best way to evaluate the Ag-gag law for North Dakota. Figure 9 shows the same graph as Figure 8 but without states that have a pre-intervention RMSPE that is 2 times larger than the RMSPE for

Figure 9: Cattle Inventory gaps in North Dakota and placebo gaps without outliers



North Dakota. Abadie et al. (2010) recommends dropping states whose pretreatment RMSPE is considerably different then the state of interest to get better idea of what is happening. Using a cutoff of 2 times the size of North Dakota's RMSPE, eliminated 10 states that didn't fit as well as North Dakota in the time period of 1980- 1989. The states that were eliminated were: Iowa, Texas, Illinois, Colorado, Missouri, Nebraska, Minnesota, Oklahoma, Wisconsin, and Arizona.

Figure 10: Ratio of post-Ag-gag RMSPE and pre-Ag-gag RMSPE: North Dakota and 26 control states

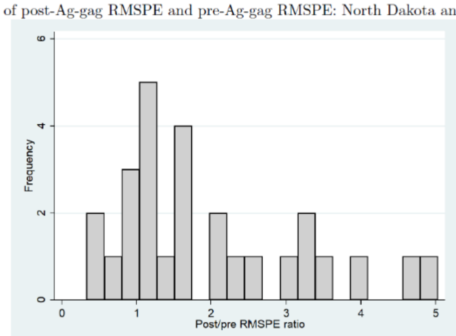


Figure 10 looks at the distribution of North Dakota gaps versus the gaps that were generated from the 26 placebo runs that took place. By using a ratio of post/pre-Ag-gag RMSPE for each state can create the distribution of these ratios to evaluate the magnitude of ratio from North Dakota versus the other ratios. North Dakota has a ratio of 1.2425, this ratio doesn't stand out compared the rest of the distributions. There are control states that have bigger ratios compared to North Dakota's and with a p-value of .66 which is far beyond the conventional .05 that is used for statistical significance. So I find no effect of the Ag-gag law on North Dakota cattle inventories. Appendix B Table 2 contains all the results for the placebo tests.

Montana Cattle

Table 7: Cattle Inventory Predictor Means for Montana

Variables	Real Montana	Synthetic Montana
Corn Price	2.81	2.80
Cattle Price	55.43	55.26
Cattle Basis	-15.60	-15.56
Corn Basis	.163	.164
Tax Burden	.092	.092
Cattle(1980(1)1990)	2.678	2.665

As a comparison to Kansas and North Dakota, I included Montana since it also passed its Ag-gag law in 1991. The predictor means are shown in Table 7 that came from constructing the synthetic Montana. The predictor means are much closer overall compared to the North

Dakota means. This suggest that the variables accurately reproduce the cattle inventory values for Montana prior to the passage of their Ag-gag law.

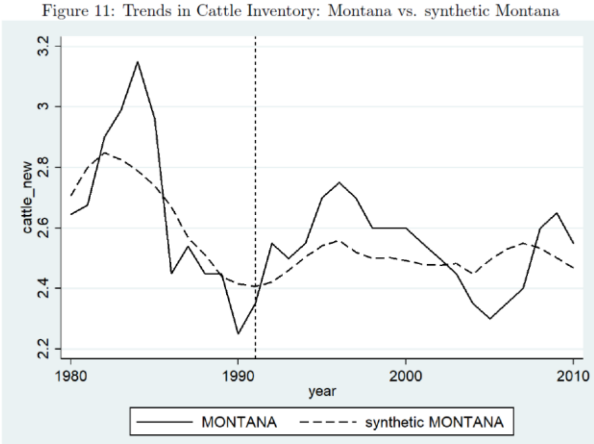
Table 8 showcases the weights that make up the synthetic Montana. According to the table, there is no single state that contributes heavily towards the synthetic Montana. Cattle inventory in Montana is best reproduced by a combination of all the states in the donor pool with most of the weight coming from Arizona, California, and Louisiana with the values .182, .14, and .21. This is a different result from North Dakota where only 3 states contributed to the synthetic counterpart.

Table 8: State Weights in the synthetic Montana

State	Weight	State	Weight
Arizona	0.182	Missouri	0.019
Arkansas	0.022	Nebraska	0.017
California	0.14	New Mexico	0.023
Colorado	0.018	Ohio	0.016
Florida	0.032	Oklahoma	0.024
Georgia	0.024	Oregon	0.016
Idaho	0.02	Pennsylvania	0.02
Illinois	0.017	South Dakota	0.019
Iowa	0.016	Tennessee	0.033
Kentucky	0.02	Texas	0.024
Louisiana	0.21	Virginia	0.019
Michigan	.012	Wisconsin	0.014
Minnesota	0.015	Wyoming	.025

Figure 11 shows the cattle inventory for Montana and its synthetic counterpart for the period of 1980-2010. The synthetic and real Montana lines while being close together they don't closely track each other on the pre-Ag-gag law period. Although there is a high degree of balance on the cattle predictors, the graph suggest that synthetic Montana might not provide a significant approximation of the number of cattle that would have been in Montana in 1992-2010 in the absence of their Ag-gag law. The estimated effect of their Ag-gag law on cattle inventory in Montana is the difference between the synthetic Montana after the law passed and the real Montana. After the

Figure 11: Trends in Cattle Inventory: Montana vs. synthetic Montana



law passed it looks like there may be an effect according to the Figure 11. The two lines diverge after 1991 but remain in close proximity.

Figure 12: Cattle Inventory Gap between Montana and synthetic Montana

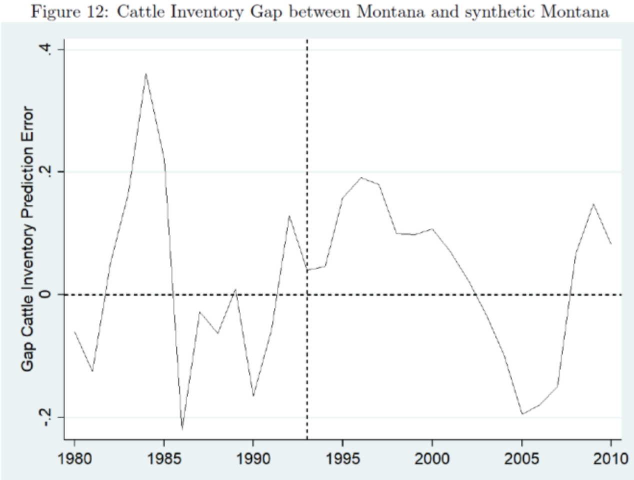
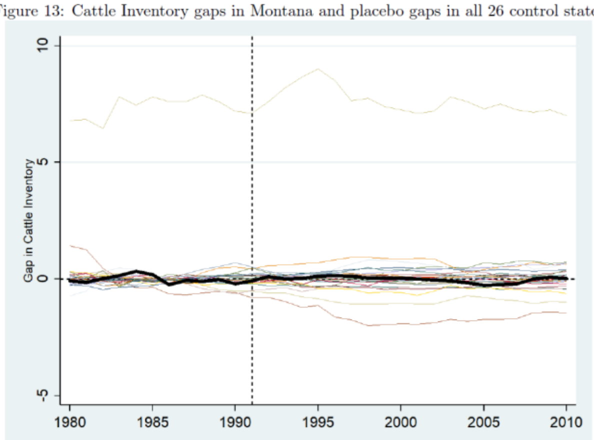


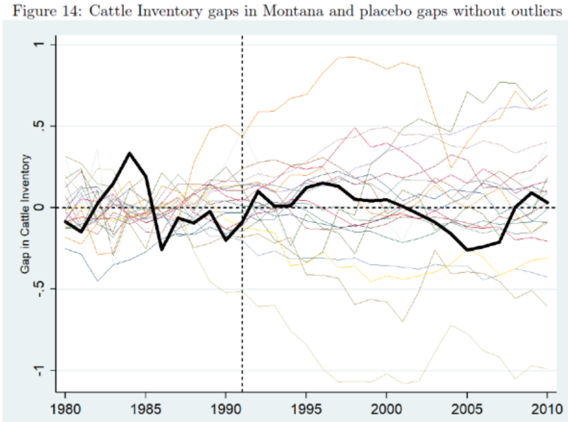
Figure 12 shows the difference between the real Montana and its synthetic counterpart trend line. It doesn't hover near zero in the pre-Ag-gag period the pre-period might not be suitable synthetic Montana. Also, the gap in after the policy intervention might suggest that there little to no effect from this policy.

Figure 13: Cattle Inventory gaps in Montana and placebo gaps in all 26 control states



To evaluate the significance of the Montana estimates, ran the same series of placebo studies mentioned above to each state in Montana's donor pool. Figure 13 shows results of the gaps from states in the donor pool along with the gap line from Montana.

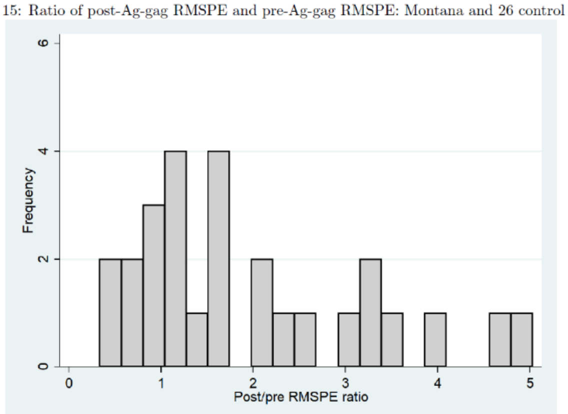
Figure 14: Cattle Inventory gaps in Montana and placebo gaps without outliers



Montana is designated with the thick black line and all the other states are designated with the thinner lines. Since Figure 13 includes all the states there are some that have a significantly larger gaps and makes it hard to see anything. Figure 14 shows a better view, I dropped states that have a pre-Ag-gag RMSPE that is two times larger than Montana's. With Montana having a pre-Ag-gag RMSPE of 164984.55, it is quite a large number. I dropped 5 states from Figure 13 to get a better look at the gaps. The dropped states are Texas, Iowa, Minnesota, Nebraska, and Wisconsin.

To determine the statistical significance of Montana's laws, I used its gap compared to the gaps obtained from the placebo studies and look at the distribution of the ratios of the Post/pre-Ag-gag RMSPE. Figure 15 displays the distribution of ratios, Montana's ratio is the fourth smallest out of 29 ratios. With a p-value of 0.8966, it is quite far from the standard .05 that is typically used for statistical significance. Therefore, magnitude of the post/pre-Ag-gag ratio is not statistically different from the rest of the ratios. If this intervention was assigned at random, the probability of getting a ratio of this size is 89.66%. There is no significant effect on cattle inventory numbers from the passage of Montana's Ag-gag law. Appendix B Table 3 contains all the results for the placebo tests.

Figure 15: Ratio of post-Ag-gag RMSPE and pre-Ag-gag RMSPE: Montana and 26 control states



Hog

I used hog inventories to provide a comparison to the cattle inventory models used above for the same states to see if the results are similar to those that were reached by synthetic control models that used cattle inventories. I used Kansas and North Dakota to provide these comparisons. Hog inventory data wasn't complete enough for an analysis of Montana. There are less observations in the hog dataset since there are only 19 states in the donor pools.

Kansas

To get a sense if the synthetic Kansas closely resembles the Kansas for the model, Table 9 compares the predictor values for each. The synthetic Kansas produces accurate predictor variables that mimic the real Kansas variables prior to the passage of their Ag-gag law in 1990. The predictor means for Kansas and its synthetic counterpart almost all the same. This is similar to the results from the Kansas cattle predictor means.

Table 9: Hog Inventory Predictor Means for Kansas

Variables	Real Kansas	Synthetic Kansas
Corn Price	2.532	2.530
Hog Price	45.08	45.02
Lean Hog Basis	-4.141	-4.139
Corn Basis	-.1275	-.1272
Tax Burden	.0938	.0936
Hog(1980(1)1989)	1.595	1.591

Table 10 displays the states that provide weight for the synthetic Kansas. The synthetic Kansas is best reproduced with all states from the donor pool providing some weight. Texas provides the most with .38, Wisconsin has a weight .32, and South Dakota has a weight of .218.

Table 10: State Weights in the Synthetic Kansas

State	Weight	State	Weight
Georgia	.003	North Carolina	.004
Illinois	.006	Ohio	.003
Indiana	.006	Pennsylvania	.001
Iowa	.03	South Carolina	.002
Kentucky	.002	South Dakota	.218
Michigan	.003	Tennessee	.004
Minnesota	.005	Texas	.38
Missouri	.006	Virginia	.001
Nebraska	.005	Wisconsin	.32

Figure 16: Trends in Hog Inventory: Kansas vs synthetic Kansas

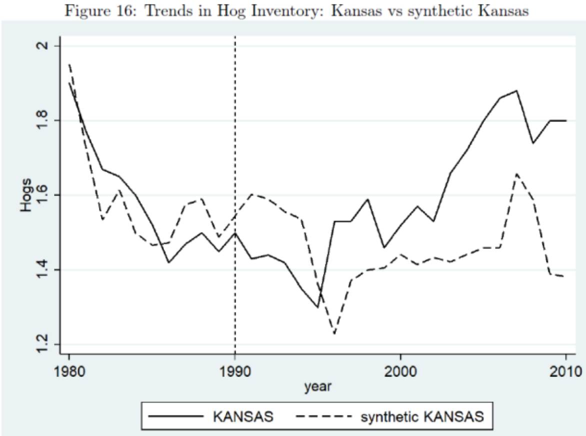
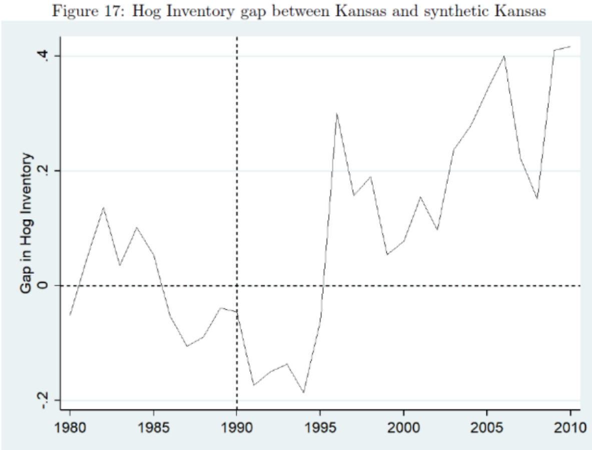


Figure 16 shows the hog inventory for Kansas and the synthetic Kansas over the time period of 1980 to 2010. This graph combined with the predictor means from Table 9, the synthetic Kansas provides a sensible approximation to the Hog inventory that would have been in Kansas from 1991 to 2010 if they didn't pass their Ag-gag law. In the period prior to 1990 the lines are close together, after 1990 synthetic Kansas diverges from the real Kansas until 1995 where they meet. After 1995 the real Kansas diverges from the synthetic Kansas for the rest of the time period. The graph suggests that at first hog inventory numbers declined then increased after 1995. Figure 17 shows yearly estimates for the gap between the real Kansas and the synthetic Kansas. After the passage of the Ag-gag law in 1990 there was at first a negative gap then around 1995 the gap becomes positive. This might due to a lagged effect from the law.

Figure 17: Hog Inventory gap between Kansas and synthetic Kansas



To determine if these results for the Kansas hog model are significant, I ran a placebo test where this intervention is assigned to every state in the donor state group. If the placebo test generates similar gaps to Kansas', then the analysis doesn't provide significant evidence of a positive effect from the Ag-gag law on farm business investment. Figure 18 shows the distribution of the placebo gaps from Kansas and all the donor states. To get a clearer picture, removed states that had a pre-RMSPE that was 2 times larger than Kansas' RMSPE. The states that I discarded from Figure 18 are Iowa, Minnesota, Indiana, Missouri, and Nebraska.

Figure 18: Hog Inventory in Kansas and placebo gaps in all 18 states

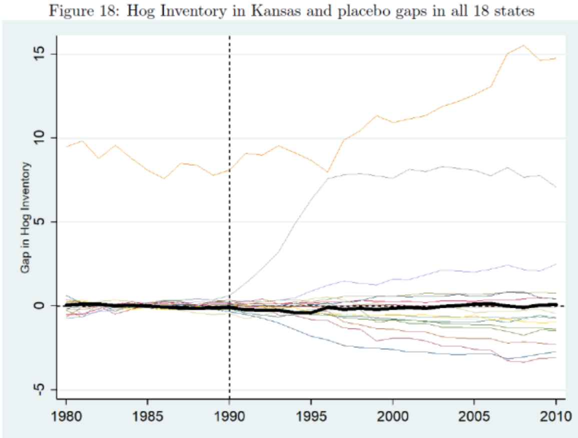


Figure 19: Hog Inventory in Kansas and placebo gaps without outliers

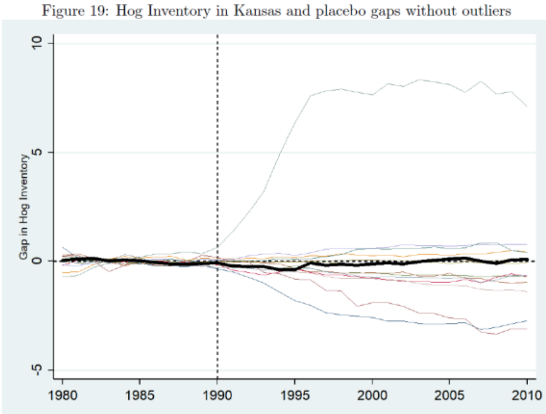
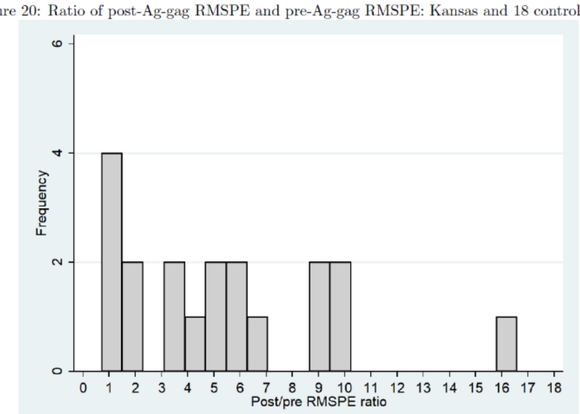


Figure 19 shows the updated graph. It looks like that Kansas doesn't seem different from the other donor states. Finally using the gaps from the placebo test can evaluate Kansas against the rest of the ratios of Post/pre-RMSPE. Using the distribution of the ratios can find the p-value of the state of interest (Kansas).

Figure 20 displays the distribution of ratios for Kansas and 19 donor states. Kansas has a Post/pre-RMSPE ratio of 1.998273, so its post-Ag-gag RMSPE is 1.99 times the pre-Ag-gag RMSPE. This value is much smaller the some of the ratios of the donor states with Kansas having the 6 smallest ratio. If this intervention was assigned at random to the data, the probability of obtaining a Post/pre-Ag-gag RMSPE the size of Kansas' is .7368. So, I find no effect of Ag-gag laws on Kansas hog inventories.

Figure 20: Ratio of post-Ag-gag RMSPE and pre-Ag-gag RMSPE: Kansas and 18 control states



Appendix B Table 4 contains all the results for the placebo tests.

North Dakota

Table 11: Hog Inventory Predictor Means for North Dakota

Variables	Real North Dakota	Synthetic North Dakota
Corn Price	2.33	2.622
Hog Price	43.96	45.54
Lean Hog Basis	-5.441	-3.869
Corn Basis	-.3139	-.0220
Tax Burden	.0975	.0945
Hog(1980(1)1990)	.2764	.4627

Table 11 displays the predictor means for the predictor variables for the hog inventory. As shown the predictor means for the synthetic North Dakota are much higher compared to the predictor variable means for the real North Dakota with the exception of corn price, lagged hog inventory, and tax burden. Compared to the Kansas Hog model, this suggests that the variables don't provide a suitable control group for North Dakota. This is consistent with the results from the North Dakota Cattle model. The weights aren't similar to the state weights from the donor pool that are used to create the synthetic North Dakota cattle model.

Table 12: State Weights in the Synthetic North Dakota

State	Weight	State	Weight
Georgia	0	North Carolina	0
Illinois	0	Ohio	0
Indiana	0	Pennsylvania	0
Iowa	0	South Carolina	1
Kentucky	0	South Dakota	0
Michigan	0	Tennessee	0
Minnesota	0	Texas	0
Missouri	0	Virginia	0
Nebraska	0	Wisconsin	0

As shown in Table 12 South Carolina provides all the weight for the synthetic North Dakota. All of the other states have a weight of zero.

Figure 21 shows the synthetic North Dakota compared to the real North Dakota over the time period from 1980 to 2010. In combination with the difference between the predictor variables means and the results in Figure 21, it suggests that the synthetic control method doesn't provide an accurate counterfactual to evaluate the 1991 Ag-gag law passage for North Dakota. The two lines appear to come closer together but never touch. This is shown more clearly by Figure 22; the line approaches the zero line but never touches. The synthetic North Dakota values for each year are consistently higher than the actual values for North Dakota.

Figure 21: Trends in Hog inventory: North Dakota vs synthetic North Dakota

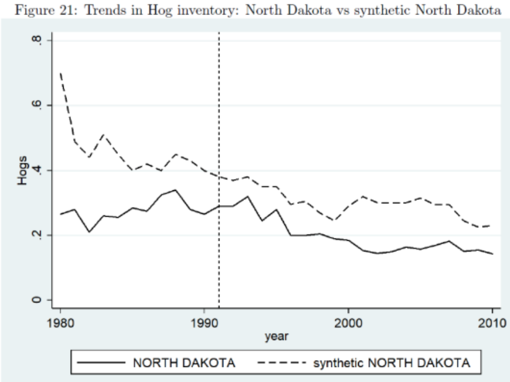
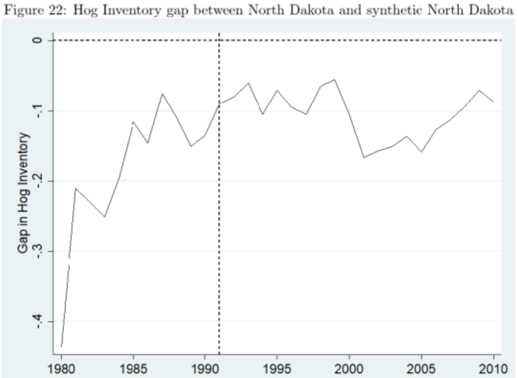


Figure 22: Hog Inventory gap between North Dakota and synthetic North Dakota



To support the evidence in the graphs and figures above, Figures 23 and 24 show the results of the placebo test gaps for North Dakota and the donor states. Figure 23 shows North Dakota and the 19 donor states. It appears that North Dakota is in the middle of all of the gaps from the placebo tests. Figure 24 provides a clearer view of North Dakota and some of. Dropped states that had a pre-RMSPE that was twice the size of North Dakota's RMSPE.

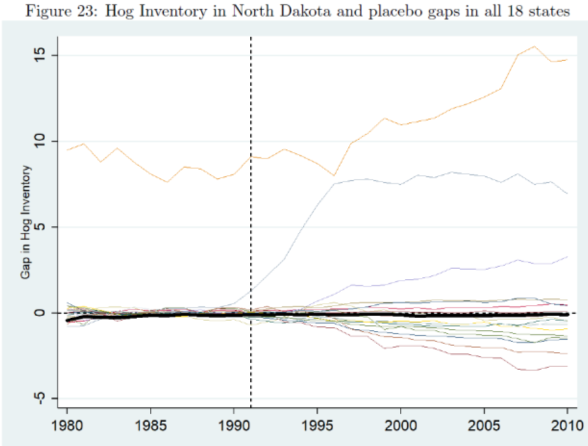


Figure 23: Hog Inventory in North Dakota and placebo gaps in all 18 states

Supporting the results from the North Dakota gap relative to the placebo gaps, using the distribution of the post/pre-Ag-gag RMSPE ratios. The North Dakota has Figure 25 shows the post/pre-Ag-gag ratios of RMSPE for North Dakota and the 18 donor states. North Dakota has a value of 0.5483, which means that the post-Ag-gag RMSPE is .5483 times smaller than the pre-Ag-gag RMPSE. North Dakota has the smallest ratio of all the states, combined with the probability getting a post/pre-Ag-gag RMSPE ratio after assigning an intervention at random is 1, North Dakota's gap is not statistically different from the placebo gaps. Therefore, I find there is absolutely no effect of

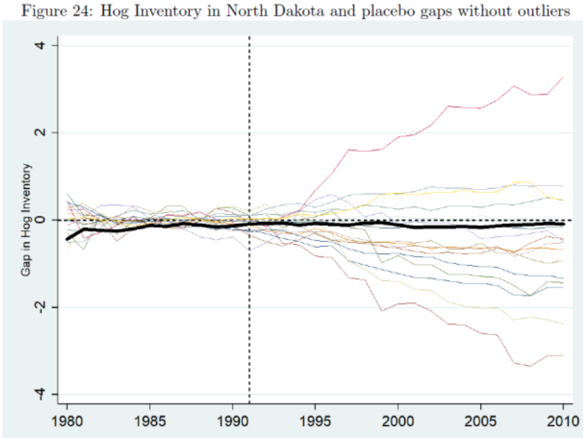


Figure 24: Hog Inventory in North Dakota and placebo gaps without outliers

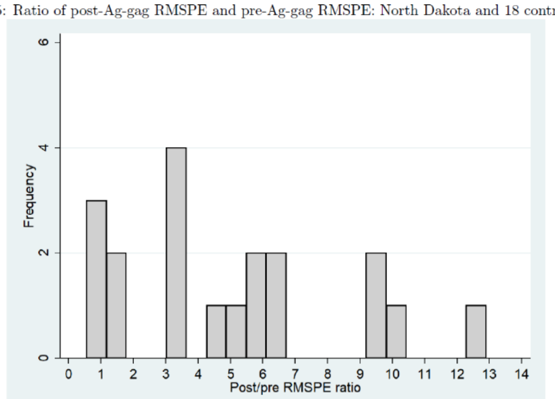


Figure 25: Ratio of post-Ag-gag RMSPE and pre-Ag-gag RMSPE: North Dakota and 18 control states

Ag-gag laws on North Dakota's hog inventories. Appendix B Table 5 contains all the results for the placebo tests.

Robustness Checks

To check the robustness of the results, ran the model over different time periods to see if the results changed. When I ran the models over the time period of 1985-2000, the synthetic Kansas, North Dakota, and Montana more closely matched their real values, but the RMSPE ratios for each of the 5 models didn't change much. The p-values became slightly smaller but not enough to reject the null of zero effect.

For Kansas, it looked like there was a lagged effect around the 1994 year for both cattle and hog models. After testing for a lag, there was no change in significance for the p-values that were calculated from the RMSPE. The RMSPE that was calculated from the placebo gaps of the donor states were larger then Kansas for both the cattle and hog models. The p-value for the Cattle model when adjusting for a lag is 0.519. The p-value for the Kansas Hog model is 0.789. There are far above the traditional .05 that is used to reject the null. So, I found that even if there was a lag in business investment, there was no effect from the Ag-gag law.

CHAPTER 7

CONCLUSION

There are important policy insights learned from this thesis. The lack of significant results from the SCM model provides that there is no effect on farm business investment from these laws. These laws were supposed to protect agricultural producers from property destruction and be unfairly represented by recordings made. By using feeder cattle and hog inventories, I can use the results from both models as comparisons for each other since both types of livestock are typically in confinement type operations. These confinement type operations are important since they are typically targeted by investigators.

The results suggest that using SCM to evaluate the effect of Kansas' Ag-gag law on both hog and cattle models, the SCM creates an accurate synthetic Kansas. While it may seem like there is an effect after looking at the graphs, if the intervention was assigned to any state in the sample at random, then the probability of obtaining results of the magnitude of Kansas would be .5556 for cattle and .7368 for hog. The graphs of that show the difference between the real Kansas and its synthetic state suggests that there may be lagged effect around 1994. After further investigation if there is a lagged effect on business investment, the results show that it is still insignificant.

The North Dakota synthetic control models suggest that using a synthetic control to evaluate the effects of their Ag-gag law may not be the best evaluation method. The predictor means for both the hog and feeder cattle did not have the same degree of balance that the Kansas and Montana models have. Ultimately after looking at the graphs and the probability of having results similar to those of North Dakota for both cattle and hog models, the results are not significant. If assigned these interventions to a state at random in the sample, then the probability of obtaining results of the magnitude of North Dakota is .66 for the cattle model, while the hog model had a probability of 1.

Montana only has a cattle model since the hog inventory data wasn't complete enough to run. Like the Kansas models, the predictor means for Montana are quite balanced. Therefore, the synthetic Montana is an accurate counterfactual to the real Montana. The graphs and the probability of getting the same magnitude obtained by Montana is quite high at .8966 if the intervention is assigned randomly to a state from the donor pool.

From both hog and cattle inventory models for each state there has shown that there is no significance effect of the Ag-gag laws on the livestock inventories, which is used as a proxy for farm business investment. These results could be due to the lack of data available over period of 1980 to 2010. Many variables that could potentially add to the model weren't available at the state level until after the laws had passed or it was severely restricted to certain number of states over the time period.

Animal welfare and consumer groups against these laws, can use these results saying there is no economic justification for these laws to be passed. Conversely, I can see advocates for these laws, saying the laws are only to protect existing business, not as way to increase investment. Further research in this area can provide more answers if the effect is zero or just insignificantly small.

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APPENDIX A

DATA SOURCES

The sources for data used in analysis:

- From NASS
    - Cattle, GE 500 lbs, $/CWT
    - Hogs prices received, $/CWT
    - Corn price received, $/bu
    - Cattle, On Feed -Inventory
    - Hog- Inventory
- Tax Foundation
    - Tax burden percentages for each state from the Tax Foundation. The percentages range from 1977 to 2012.
- Historical Continuous Futures from Quandl
    - Feeder Cattle- FC4 average annual settling price, cents per lb
    - Lean Hogs- LN4 average annual settling price, cents per lb
    - Corn – C4 average annual settling price, cents per bu
- Basis for Feeder Cattle, Lean Hogs, and Corn Futures
    - Calculated by using cash prices received from above from each state for each basis variable and subtracted futures prices.

APPENDIX B

ADDITIONAL TABLES

Table 1: RMSPE for Kansas Cattle

State	pre-RMSPE	post-RMSPE	Ratio	Rank	p-value
IOWA	0.1175	0.9163	7.7969	1	0.0370
NEBRASKA	0.0832	0.5544	6.6603	2	0.0741
OHIO	0.0738	0.3609	4.8905	3	0.1111
NEW MEXICO	0.0884	0.3350	3.7907	4	0.1481
ILLINOIS	0.2155	0.7129	3.3079	5	0.1852
WYOMING	0.0793	0.2601	3.2818	6	0.2222
MICHIGAN	0.0347	0.1115	3.2178	7	0.2593
IDAHO	0.1119	0.3287	2.9369	8	0.2963
OREGON	0.0765	0.2129	2.7821	9	0.3333
CALIFORNIA	0.1016	0.2718	2.6765	10	0.3704
KENTUCKY	0.0865	0.2204	2.5482	11	0.4074
COLORADO	0.2604	0.6597	2.5331	12	0.4444
LOUISIANA	0.0416	0.1025	2.4620	13	0.4815
MISSOURI	0.1030	0.2505	2.4328	14	0.5185
PENNSYLVANIA	0.0749	0.1611	2.1513	15	0.5556
TENNESSEE	0.0599	0.1099	1.8351	16	0.5926
ARKANSAS	0.0991	0.1665	1.6794	17	0.6296
WISCONSIN	0.2472	0.3754	1.5188	18	0.6667
KANSAS	0.1568	0.2097	1.3373	19	0.7037
OKLAHOMA	0.1576	0.2100	1.3321	20	0.7407
SOUTH DAKOTA	0.1319	0.1381	1.0473	21	0.7778
TEXAS	7.6198	7.9334	1.0412	22	0.8148
FLORIDA	0.0441	0.0426	0.9655	23	0.8519
GEORGIA	0.0627	0.0532	0.8479	24	0.8889
MINNESOTA	0.2671	0.2155	0.8068	25	0.9259
VIRGINIA	0.0845	0.0540	0.6393	26	0.9630
ARIZONA	0.1834	0.0841	0.4588	27	1.0000

Table 2: RMSPE for North Dakota Cattle

State	pre-RMSPE	post-RMSPE	Ratio	Rank	p-value
OHIO	0.0693	0.3488	5.0324	1	0.0370
IDAHO	0.0853	0.4073	4.7774	2	0.0741
NEW MEXICO	0.0987	0.3818	3.8683	3	0.1111
WYOMING	0.0729	0.2632	3.6115	4	0.1481
LOUISIANA	0.1077	0.3546	3.2920	5	0.1852
ILLINOIS	0.2850	0.9253	3.2466	6	0.2222
CALIFORNIA	0.1559	0.4888	3.1355	7	0.2593
COLORADO	0.2803	0.7055	2.5175	8	0.2963
MISSOURI	0.1957	0.4632	2.3669	9	0.3333
IOWA	0.7385	1.6221	2.1965	10	0.3704
MICHIGAN	0.0570	0.1167	2.0477	11	0.4074
ARKANSAS	0.1146	0.1996	1.7426	12	0.4444
NEBRASKA	0.3383	0.5483	1.6207	13	0.4815
KENTUCKY	0.1205	0.1914	1.5883	14	0.5185
GEORGIA	0.0683	0.1039	1.5207	15	0.5556
FLORIDA	0.0649	0.0925	1.4253	16	0.5926
OREGON	0.0965	0.1218	1.2615	17	0.6296
NORTH DAKOTA	0.0927	0.1152	1.2425	18	0.6667
MINNESOTA	0.3441	0.3984	1.1578	19	0.7037
VIRGINIA	0.1193	0.1336	1.1197	20	0.7407
TEXAS	7.3592	7.6592	1.0408	21	0.7778
PENNSYLVANIA	0.1006	0.0935	0.9299	22	0.8148
TENNESSEE	0.1293	0.1193	0.9221	23	0.8519
SOUTH DAKOTA	0.1566	0.1260	0.8047	24	0.8889
OKLAHOMA	0.2401	0.1582	0.6587	25	0.9259
WISCONSIN	0.3579	0.1675	0.4680	26	0.9630
ARIZONA	0.2558	0.0855	0.3344	27	1.0000

Table 3: RMSPE for Montana Cattle

State	pre-RMSPE	post-RMSPE	Ratio	Rank	p-value
OHIO	0.0693	0.3488	5.0324	1.0000	0.0345
IDAHO	0.0853	0.4073	4.7774	2.0000	0.0690
NEW MEXICO	0.0987	0.3818	3.8683	3.0000	0.1034
WYOMING	0.0729	0.2632	3.6115	4.0000	0.1379
LOUISIANA	0.1077	0.3546	3.2920	5.0000	0.1724
ILLINOIS	0.2850	0.9253	3.2466	6.0000	0.2069
CALIFORNIA	0.1559	0.4888	3.1355	7.0000	0.2414
COLORADO	0.2803	0.7055	2.5175	8.0000	0.2759
MISSOURI	0.1957	0.4632	2.3669	9.0000	0.3103
IOWA	0.7385	1.6221	2.1965	10.0000	0.3448
MICHIGAN	0.0570	0.1167	2.0477	11.0000	0.3793
ARKANSAS	0.1146	0.1996	1.7426	12.0000	0.4138
NEBRASKA	0.3383	0.5483	1.6207	13.0000	0.4483
KENTUCKY	0.1205	0.1914	1.5883	14.0000	0.4828
GEORGIA	0.0683	0.1039	1.5207	15.0000	0.5172
FLORIDA	0.0649	0.0925	1.4253	16.0000	0.5517
OREGON	0.0965	0.1218	1.2615	17.0000	0.5862
MINNESOTA	0.3441	0.3984	1.1578	18.0000	0.6207
VIRGINIA	0.1193	0.1336	1.1197	19.0000	0.6552
TEXAS	7.3592	7.6592	1.0408	20.0000	0.6897
PENNSYLVANIA	0.1006	0.0935	0.9299	21.0000	0.7241
TENNESSEE	0.1293	0.1193	0.9221	22.0000	0.7586
SOUTH DAKOTA	0.1566	0.1260	0.8047	23.0000	0.7931
MONTANA	0.1648	0.1227	0.7442	24.0000	0.8276
OKLAHOMA	0.2401	0.1582	0.6587	25.0000	0.8621
WISCONSIN	0.3579	0.1675	0.4680	26.0000	0.8966
ARIZONA	0.2558	0.0855	0.3344	27.0000	0.9310

Table 4: RMSPE for Kansas Hogs

State	pre-RMSPE	post-RMSPE	Ratio	Rank	p-value
NORTH CAROLINA	0.4295	7.1229	16.5831	1	0.0526
ILLINOIS	0.2207	2.0858	9.4489	2	0.1053
OHIO	0.0762	0.7196	9.4443	3	0.1579
GEORGIA	0.2609	2.4239	9.2908	4	0.2105
TEXAS	0.0541	0.4982	9.2004	5	0.2632
MINNESOTA	0.2540	1.6855	6.6347	6	0.3158
PENNSYLVANIA	0.1001	0.6143	6.1364	7	0.3684
NEBRASKA	0.2625	1.4973	5.7038	8	0.4211
WISCONSIN	0.1742	0.9036	5.1879	9	0.4737
KENTUCKY	0.1044	0.5332	5.1085	10	0.5263
TENNESSEE	0.1607	0.6302	3.9225	11	0.5789
SOUTH DAKOTA	0.1731	0.5966	3.4463	12	0.6316
INDIANA	0.2980	0.9970	3.3459	13	0.6842
KANSAS	0.0885	0.1769	1.9983	14	0.7368
SOUTH CAROLINA	0.0349	0.0662	1.8985	15	0.7895
IOWA	8.6704	11.6379	1.3423	16	0.8421
MICHIGAN	0.2574	0.3027	1.1760	17	0.8947
MISSOURI	0.3188	0.3415	1.0713	18	0.9474
VIRGINIA	0.0680	0.0484	0.7116	19	1.0000

Table 5: RMSPE for North Dakota Hogs

State	pre-RMSPE	Post-RMSPE	Ratio	Rank	p-value
NORTH CAROLINA	0.5563	7.1759	12.9002	1	0.0526
ILLINOIS	0.2113	2.1481	10.1673	2	0.1053
MINNESOTA	0.2179	2.1307	9.7777	3	0.1579
TEXAS	0.0578	0.5327	9.2119	4	0.2105
KENTUCKY	0.0877	0.5376	6.1279	5	0.2632
NEBRASKA	0.2595	1.5872	6.1161	6	0.3158
PENNSYLVANIA	0.1128	0.6358	5.6378	7	0.3684
GEORGIA	0.2174	1.2232	5.6272	8	0.4211
OHIO	0.1180	0.5966	5.0579	9	0.4737
WISCONSIN	0.1933	0.8896	4.6027	10	0.5263
SOUTH DAKOTA	0.1723	0.5947	3.4517	11	0.5789
INDIANA	0.2941	1.0147	3.4506	12	0.6316
TENNESSEE	0.1624	0.5386	3.3170	13	0.6842
SOUTH CAROLINA	0.0420	0.1305	3.1038	14	0.7368
IOWA	8.7070	11.7563	1.3502	15	0.7895
MICHIGAN	0.2502	0.3147	1.2580	16	0.8421
MISSOURI	0.3587	0.3291	0.9174	17	0.8947
VIRGINIA	0.0642	0.0532	0.8277	18	0.9474
NORTH DAKOTA	0.2016	0.1105	0.5483	19	1.0000